The Key to Weapons that Work

Dr. Charles E. McQueary
Director of Operational Test and Evaluation

Dr. Charles E. McQueary has an extensive background in defense systems combined with a doctorate in mechanical engineering. His involvement with the National Security Industrial Association and the defense community has given him a first-hand familiarity with both security issues and technologies. Set to retire from the private sector, he instead took the position as the first under secretary for the Department of Homeland Security's Science and Technology Directorate in 2003. On July 27, 2006, McQueary was sworn in as director of operational test and evaluation (OT&E). *Defense AT&L* interviewed McQueary in October 2007 to hear his views on how the test and evaluation community is working to better serve the warfighter's needs.

Q

You became the director of OT&E—operational test and evaluation—in July of 2006. Can you give us an overview of the major roles and responsibilities of your new position?

A

As the director, I am responsible to the secretary of defense and to Congress for determining that operational testing is properly planned and adequately conducted, and for determining the operational effectiveness and suitability of a system for carrying out the intended missions of the warfighter. Operational effectiveness signifies the level of mission accomplishment when a new system is employed by typical users in the planned combat environment. Operational suitability is the level of system reliability, availability, and maintainability achieved in order to support use when needed.

I am also responsible for oversight and test plan approval for Live Fire T&E for the department, and for reviewing and making recommendations to the secretary of defense

> The DoD acquisition process, of which T&E is a part, is in essence a partnership between government and private industry that has the warfighter at its heart and as its main concern.
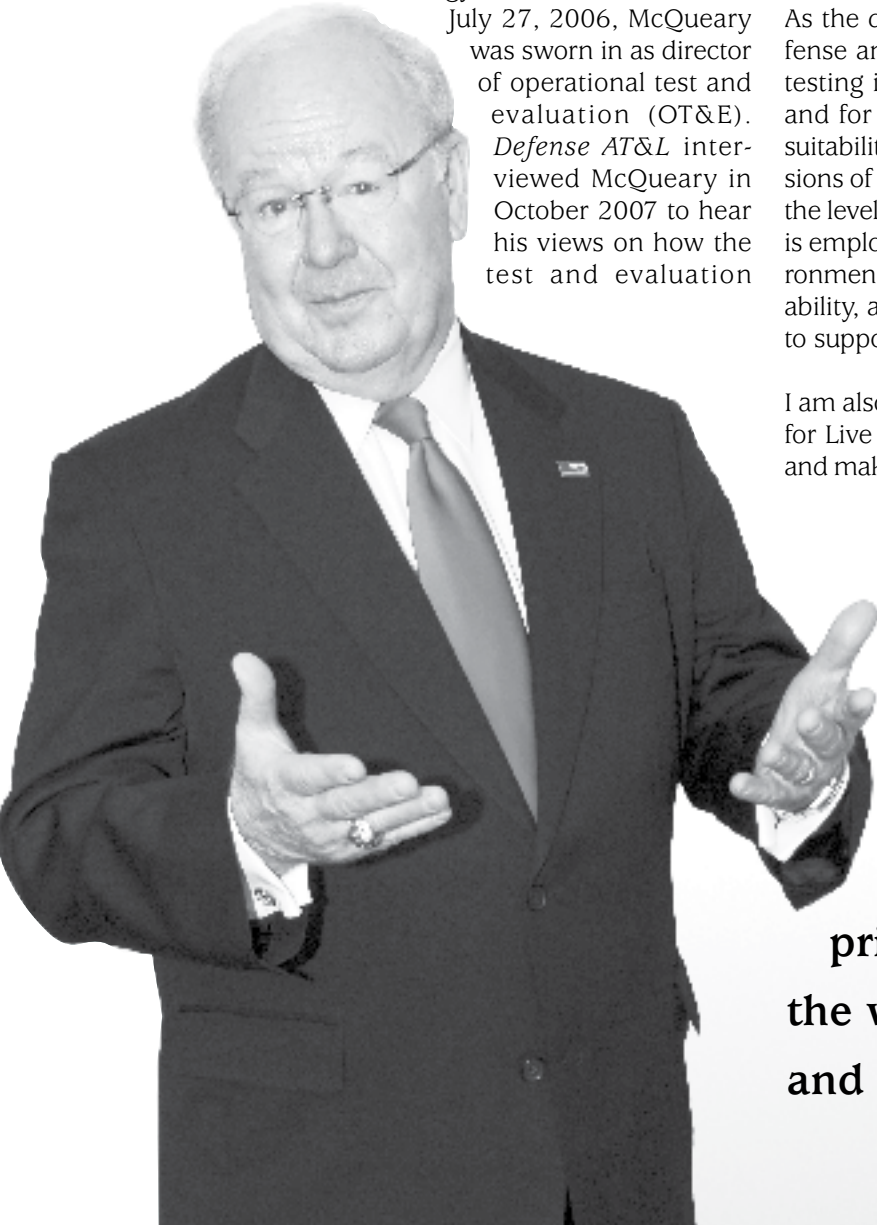
on all budgetary and financial matters relating to operational test and evaluation, including operational test facilities and equipment.

Q

The OT&E is called "the key to weapons that work." Given the current operations tempo, your mission is critical. Can you give us some examples of how your department is supporting the warfighter?

A

My staff is closely engaged with the program managers of the major defense acquisition programs most critical to our warfighters, such as mine-resistant ambush-protected (MRAP) vehicles. Our responsibility is to make certain that the systems work as intended by demonstrating mission performance in realistic environments prior to delivery to the warfighter. These demonstrations take place on a continual basis as the Service operational test agencies, staffed by military personnel who were warfighters in previous assignments, conduct early assessments on systems in development. This provides a user's perspective on how the developing systems are likely to work, identifies risk areas, and informs the decision makers who approve the systems' progression through development and demonstration.

As the developing systems mature, my staff works with the Service acquisition officials and operational test agencies to influence the planning of adequate operational test and evaluation prior to the full-rate production decisions. As the Services pursue more creative and agile acquisition approaches, especially for software-intensive systems, my staff works with them to adapt the operational test and evaluation strategies so that "weapons that work" are delivered to our warfighters on time.

OT&E also provides support to combatant commanders and deployed forces in Iraq and Afghanistan through programs such as our information assurance/information operations training and assessment program, munitions effectiveness/explosives in-theater assessments, Joint IED—improvised explosive devices—Defeat Organization test efforts, and body armor assessment testing.

Other examples of direct support to the warfighter: Our Center for Countermeasures has conducted countermeasures training for deploying forces through individual Service and joint training exercises; and our Joint Test and Evaluation Program has developed and provided streamlined tactics, techniques, and procedures in the areas of force protection, enhanced communications, weapon system employment, command and control, and logistics.

Q

One of the priorities of OT&E is to conduct test and evaluation of rapid materiel equipping initiatives. What kind

of challenges do these short timeframes and rapid turn-arounds present to the testing community?

A

The basic challenge to the OT&E community of the shortened timelines involved in rapid acquisition and urgent operational requirements is to provide the warfighters enough information on the systems so that they can employ them as quickly and with as much confidence as possible. That is critical; if a system can't be counted on to perform when needed, not only is mission success jeopardized, but our warriors will develop doubts about the weapon system's performance, which can impact both individual and organizational mission performance.

One response to the challenge: The OT&E community sometimes worked around the clock at ranges such as Yuma and Aberdeen to provide 24- or 48-hour turn-arounds for information on critical equipment and systems, such as body and vehicle armor.

Testers are also working to help meet the urgent needs of our warfighters in the critical mission of defeating IEDs. The Army Test & Evaluation Command (ATEC) has taken on the mission to plan, conduct, and report the results of tests, simulations, experiments, and evaluations to ensure our warfighters have the right capabilities for success across the entire spectrum of operations. As part of these efforts, testers at ATEC are conducting rapid testing in direct support of the warfighter to provide information on the capabilities and limitations of untested weapon systems issued directly to our soldiers conducting combat operations. The Joint IED Defeat Organization expects testers to use flexible, streamlined, and tailored test procedures based on standard test protocols. That includes reusing knowledge and data from other projects; sharing data among Services and agencies; and providing concise and timely reports to enable decisions on fielding, improvement, or termination.

Like the Army, the Air Force T&E community is working hard to be responsive to the urgent operational needs of our warfighters and is providing rapid evaluations of components for urgently needed capabilities such as integrated base defense security, and Global Hawk and small diameter bomb employment.

The Navy T&E community response across the entire spectrum of urgently needed warfighter capabilities includes efforts to evaluate and provide information on the Counter-Bomb/Counter-Bomber Advanced Concept Technology Demonstration, which will help meet evolving, asymmetrical, and sophisticated terrorist threats. These detection and mitigation systems will provide force protection personnel with the latest concept of operations, tactics, techniques, and procedures; and with rules of engagement generation, update, and dissemination.

Dr. Charles E. McQueary

Director of Operational Test and Evaluation

Dr. Charles E. McQueary was sworn in as director of operational test and evaluation on July 27, 2006. A presidential appointee confirmed by the U.S. Senate, he serves as the senior advisor to the secretary of defense on testing Department of Defense weapon systems, and prescribing policies and procedures for the conduct of operational and live fire test and evaluation.

Prior to his current appointment, McQueary was confirmed by the U.S. Senate in March 2003 as the first under secretary for science and technology at the Department of Homeland Security. In that position, he led the research and development arm of DHS, utilizing the nation's scientific and technological resources to provide federal, state, and local officials with the technology and capabilities to protect the homeland.

McQueary is a former president of General Dynamics Advanced Technology Systems, in Greensboro, N.C. He has also been president and vice president of business units for AT&T and Lucent Technologies, and a director for AT&T Bell Laboratories.

Early in his career at Bell Laboratories, McQueary served as head of the Missile Operations Department for the SAFE-GUARD Antiballistic Missile Test Program, based at Kwajalein in the Marshall Islands. He later headed Bell Laboratories' Field Operations Department in Great Britain in support of a Navy oceanographic research station. He also served as the director of the Undersea Systems Development Lab.

McQueary is a former executive board member of the National Security Industrial Association and the American Defense Preparedness Association (both later combined to form the National Defense Industrial Association). He is a past chairman of the Undersea Warfare Systems Division of the American Defense Preparedness Association, and a former member of the Navy League Industrial Executive Board, the Navy Submarine League, the Electronics Industries Association, the American Society of Mechanical Engineers, and the American Association for the Advancement of Science. He is also the recipient of the National Defense Industrial Association Homeland Security Leadership Award.

A native of Texas, McQueary is a graduate of The University of Texas, Austin, where he earned a bachelor's and a master's degree in mechanical engineering, and a doctorate in engineering mechanics, the latter two as a NASA Scholar. He is a member of five academic honor societies. The University of Texas has named McQueary a Distinguished Engineering Graduate.

Another way that testers are meeting the challenge of shortened timelines is to work in theater to ensure that information needs are identified to stateside test ranges and that the information supplied from the ranges is relevant and properly reported to our forces. This response by the T&E community is especially noteworthy because it often involves a level of commitment and sacrifice that is outside the typical test and evaluation operating envelope. It exemplifies the ends to which the T&E community is prepared to go to support our warfighters.

Q

You have put a great emphasis on reaching out to academic and scientific communities and on building bridges with private enterprise. What types of benefits accrue from these relationships? What are you doing to encourage continued communication?

A

I believe that communication between government and private industry is absolutely critical so we can jointly review issues of common interest and concern and review those encompassing T&E policies and procedures that impact weapons systems development, procurement, and use. This is critical because the DoD acquisition process, of which T&E is a part, is in essence a partnership between government and private industry that has the warfighter at its heart and as its main concern. We need to communicate and understand each other so we can work as smoothly and efficiently as possible in support of our warfighters.

To maintain and participate in this dialogue with private industry, OT&E participates in several government/private industry forums. One such forum is the National Defense Industrial Association's Industrial Committee on Operational Test and Evaluation, or the ICOTE. The ICOTE is chaired by Larry Graviss (a representative from private industry) and meets four times a year to discuss important and emerging T&E policies and issues. OT&E is also working with the Government Electronics and Information Technology Association—a standards house—to facilitate a new reliability program standard that will assist PMs in setting up and managing effective reliability programs, based upon industry best practices.

OT&E also participates on Defense Science Board task forces that survey private industry for best practices that are applicable to acquisition and T&E. We've also commissioned reports from the

National Academy of Sciences on how private industry conducts T&E.

Through these forums, OT&E maintains close communication with private industry so that the government/private industry partnership concerned with acquisition of major systems for our warfighters is as strong and as effective as possible.

Q

You've stated that many challenges, such as cost growth and technology readiness problems, could be greatly reduced if more emphasis was placed on the early phases of the development process. Could you expand on that?

A

I strongly believe that OT&E should be a process of confirmation and not one of discovery. Unfortunately, OT&E is too often the place where performance shortcomings and new failure modes are discovered. When problems are discovered late in the acquisition process, the cost to fix these problems is much higher than if they were discovered earlier. In addition, the time lost when problems are found at this stage can be substantial—and when our forces need a new capability, the latter penalty may be even more substantial than increased cost.

To move OT&E into the role of confirmation and away from the role of a discoverer of problems, we must do two things: We must incorporate operational realism into developmental testing to gain operational insights and identify failure modes as early as possible; and we must infuse sound reliability engineering practices into the systems engineering and developmental testing stage. Poor reliability drives down mission accomplishment and affordability and drives up force structure, total cost of ownership, and the logistics footprint.

To incorporate operational realism into developmental testing, OT&E is working with the Service OTA—operational test authority—commanders who share this goal. And to infuse sound reliability engineering practices into the systems engineering and developmental testing process, OT&E has worked with the under secretary of defense for acquisition, technology and logistics to update the DoD RAM [*Reliability, Availability, and Maintainability*] Handbook, and to write and submit a congressionally mandated report on current T&E policies and practices and how they can be improved. To further pursue the goal of increased reliability, OT&E and OUSD(AT&L) are jointly sponsoring a Defense Science Board Task Force that will examine how to strengthen developmental T&E oversight, and we are working together to provide some guidance for the development of the mandatory key performance parameters for materiel availability. OT&E and OUSD(AT&L) are also working with the Joint Staff on a method for developing and justifying reliability, availability, and maintainability requirements, and looking at the system development contracting process—specifically the request for proposal to industry—to determine how to include reliability requirements in the system development statement of work.

Q

A recent study commissioned by your department looked at the empirical relationships between reliability investment and life-cycle support costs. It suggests a relationship between achieved reliability improvement and reduction in overall support costs. Is there a growing emphasis on establishing reliability goals and reliability improvements into programs? How might this focus affect OT&E operations?

A

DoD is placing a strong emphasis on reliability because it directly impacts the safety, functionality, and cost of our systems. This is evidenced by Joint Requirements Oversight Committee approval of the materiel availability key performance parameter, which has both reliability and ownership costs as key systems attributes. Test results since 2001 show that almost 50 percent of DoD's programs in oversight are unsuitable at the time of initial operational test and evaluation—IOT&E—because they do not achieve reliability goals. When I became the director of OT&E, I made system suitability the number one priority because reliability is a key enabler of suitability, and it directly impacts design and development costs, support costs, logistics footprint, and system downtime.

In this vein, the Joint Staff and the Office of the Secretary of Defense are sponsoring a number of initiatives to increase emphasis on reliability. The study you referenced, which showed the empirical relationships between reliability investment and life-cycle support costs, is one of these initiatives and was conducted by the Logistics Management Institute.

Some other initiatives are developing the RAM Rational Guide; incorporating reliability metrics into the major defense acquisition program oversight process; facilitating a new commercial/government reliability program standard to assist PMs in setting up and managing effective reliability programs; and developing common standards testing for the OTAs to use during testing for sustainability and reliability.

The expected effect on OT&E operations will be a greater percentage of programs entering IOT&E that have demonstrated robust reliability designs and planned reliability growth during developmental testing. Historical data shows that nearly 60 percent of the programs that pass developmental testing also pass OT&E. We expect to see an increase in the number of DoD programs successfully passing IOT&E the first time around.

Q

AFOTEC, the Air Force Operational Test and Evaluation Center, has begun to implement a capability-based rating system. Can you describe this approach and how it compares to the effectiveness and suitability-based rating system? Is it a more responsive approach?

A

I view the AFOTEC capability-based rating system as a well-intentioned process improvement to make their products more meaningful and responsive to the warfighter. The capability-based approach presented assessments at a higher level than the operational effectiveness (can warfighters execute their mission with the system?) and suitability (can the system be used in the field by typical users?) approaches. The premise was to assess the critical operational issues to ultimately resolve how capable a unit equipped with the system under test is of performing its intended missions.

The AFOTEC's capability-based approach has continued to evolve over the last year to focus more on earlier operational testing involvement and improved suitability, but it engendered a greater dialogue between all the operational testers, improving the operational testing process.

This discourse allowed us to move further away from the pass/fail mentality to one of providing independent assessments of capabilities and limitations of the systems we test. I see the AFOTEC initiative as a good example of a process improvement that created a greater dialogue and understanding with the developmental testers and acquisition community, allowing us to present our best judgments earlier in acquisition to the capability demonstrated to date in the environments to which the system has been subjected.

Q

There have been many studies that look at how commercial enterprises conduct testing and evaluation. Industry tends to test earlier in a program's development, and testing is seen as an integral part of a program's success. Is DoD testing and evaluation able to import some commercial best practices?

A

Yes; in fact, one of the OSD reliability-improvement initiatives currently under way is to facilitate development of a new commercial/government reliability program standard within the Government Electronics Information Technology Association standards process. Unlike the cancelled MIL-STD-785B, which was not effective in developing highly reliable systems, this standard will include a number of commercial best practices. In addition to testing the inherent reliability of the design in the design phases, the new standard will embrace a number of other best practices such as emphasizing the importance of thoroughly understanding reliability requirements to characterize and shape the reliability program; and ensuring that reliability objectives are an integral part of the business strategy and

> I strongly believe that OT&E should be a process of confirmation and not one of discovery. When problems are discovered late in the acquisition process, the cost to fix these problems is much higher than if they were discovered earlier.

have demonstrated commitment of senior management, that reliability tasks are an integral part of the systems engineering process and should be addressed concurrently with other engineering and design activities beginning early in the design phase, that use environment and duty cycles along with their related stresses must be understood for entire life cycle, and that root-cause analysis of critical failure modes must be accomplished to eliminate or minimize their consequences.

Q

Historically, there has often been an adversarial relationship between PMs and the testing community. Test scores have been perceived as scorecards that might indicate whether the program is to continue or to receive further funding. A new emphasis sees testing as an opportunity to capture knowledge and fix problems much earlier in a program's development. Do you see a cultural change occurring? Are attitudes shifting?

A

In my experience as the director of OT&E, I would certainly not characterize relationships between program managers and the test community as adversarial. Although I can't comment on the historical approaches of others to OT&E, my experience in private industry reinforces the view that successful programmers and testers always find a way to partner in pursuit of a common objective, like producing weapon systems that work. Those who have participated in the acquisition process clearly understand there will always be fundamental challenges associated with cost, schedule, and performance. The very nature of those pressures almost always produces friction. Some view friction negatively; my personal view is that programmatic tension tends to have a strengthening effect that usually results in a better product.

With regard to the impact of test performance on funding decisions, OT&E is very careful to stay in its lane. Our mandate is to provide the acquisition decision maker our independent assessment of a system's operational effectiveness and suitability based on an adequate operational test. I believe OT&E does this very well. We fully understand that our assessment will be one of many inputs that acquisition decision makers will use to make tough calls in an environment of scarce resources.

As you mentioned, there may also be a new, emerging dynamic of test-fix-test based on meeting urgent field requirements. The MRAP testing is a great example. As the vehicles go through developmental testing at Aberdeen Test Center, soldiers and Marines with recent combat experience are working closely with industry to identify operational problems. Industry then moves immediately to fix or change such items as door locations, hatches, seats, gunner cupolas, and internal equipment. So industry can use a pencil eraser on an MRAP design rather than re-

engineer an entire production line. The cost savings and reduced response cycle times are quite evident.

At the same time, it is probably unrealistic to expect this type of operational involvement on every system undergoing developmental testing. There are simply not enough operators to spread around the developmental test community. What we can and should do is capture the lessons learned from a fast-moving program like MRAP and see if we can apply them across the acquisition community.

Q

How is OT&E working with program managers in the early phases of a program? How much influence should OT&E have, for example, in the initial capability document design? Is there effective communication at this stage in the process?

A

We work with program management right from the start of the program. The acquisition strategy is something with which we must concur because it has a section on the T&E strategy, which is near the beginning of the acquisition strategy—confirming T&E's importance.

Although this kind of formal communication is effective, we also work within the early phases of a program in many informal ways. An example of this is how we work with the requirements community within the JCIDS [*Joint Capabilities Integration and Development*] process to help define requirements in a meaningful, testable way.

It is also important to understand that OT&E is not the only operational test and evaluation influence. The Service OTAs also interact and have some influence in the early phases of a program. The example they would probably feel most comfortable with is their commenting on the testability of a requirement.

To be a bit philosophical, the influence we should have should come from the insight testing can give a program on its progress and its risk areas. To increase the value of this kind of early insight, OT&E is working with the Service OTAs to increase operational realism in early testing so there will be fewer surprises in IOT&E.

Q

It has been suggested that spiral development allows for testing much earlier in a program's design, instead of near the end of development as has been the case in previous years. Do you see this type of testing yielding promising results?

A

Testing early in the program's design phase is almost always worth it, no matter what you call the design process, and infusing operational realism early in testing only

makes early testing more valuable. It's the concept that is important, not what you call it—especially when you consider that the phase "spiral development" is scheduled to be dropped from the Acquisition Guidebook. So your point that "early is good" is the concept that must survive, and not necessarily any particular name or phase that we may use to describe it.

Q
Are there other topics you'd like to share with our readers?

A
I'd like to talk about the Department's transition to net-centric systems and how some have suggested that the current testing process doesn't provide the agility and flexibility needed to keep pace.

There is no doubt that the transition to net-centric systems poses new challenges for the acquisition community. Keeping up with the rapid pace of development in information systems and with the complex interaction of the multitude of systems is inherently challenging. We are also confronted with the sometimes competing goals of ensuring our information systems are interoperable with both civil and international partners while simultaneously assuring their security. To help meet this challenge, I recently established a new position for a deputy director for net-centric and space systems. This raises net-centric and space systems oversight to the same management level as air, land, and naval warfare.

The new approaches being employed for the development of systems such as the Net-Enabled

Combat Capability, or NECC, have led us to adapt and expand proven practices such as our Risk Assessment Level of Test process to better meet both developer and warfighter needs. The RALOT process has been used for several years to assess the level of testing needed for periodic software updates after completion of a program's IOT&E. I recently approved the piloting of a new approach. For NECC, the Joint System Test Team will use the RALOT process prior to IOT&E to assess the level of testing that is appropriate to the risk associated with the individual capability module being developed.

At the same time, we are examining the results of our information assurance and interoperability assessments of fielded systems to identify key focus areas for both system developers and testers.

Realistic testing of complex networks in a dynamic environment remains a challenge. We are looking to partner, where feasible, with the training community to leverage live, virtual, and constructive events to provide the most realistic environment for assessing the operational effectiveness, suitability, and survivability of these critical combat systems.

Q
Dr. McQueary,
thank you.

Some view friction negatively; my personal view is that programmatic tension tends to have a strengthening effect that usually results in a better product.